Resident Lake Fish

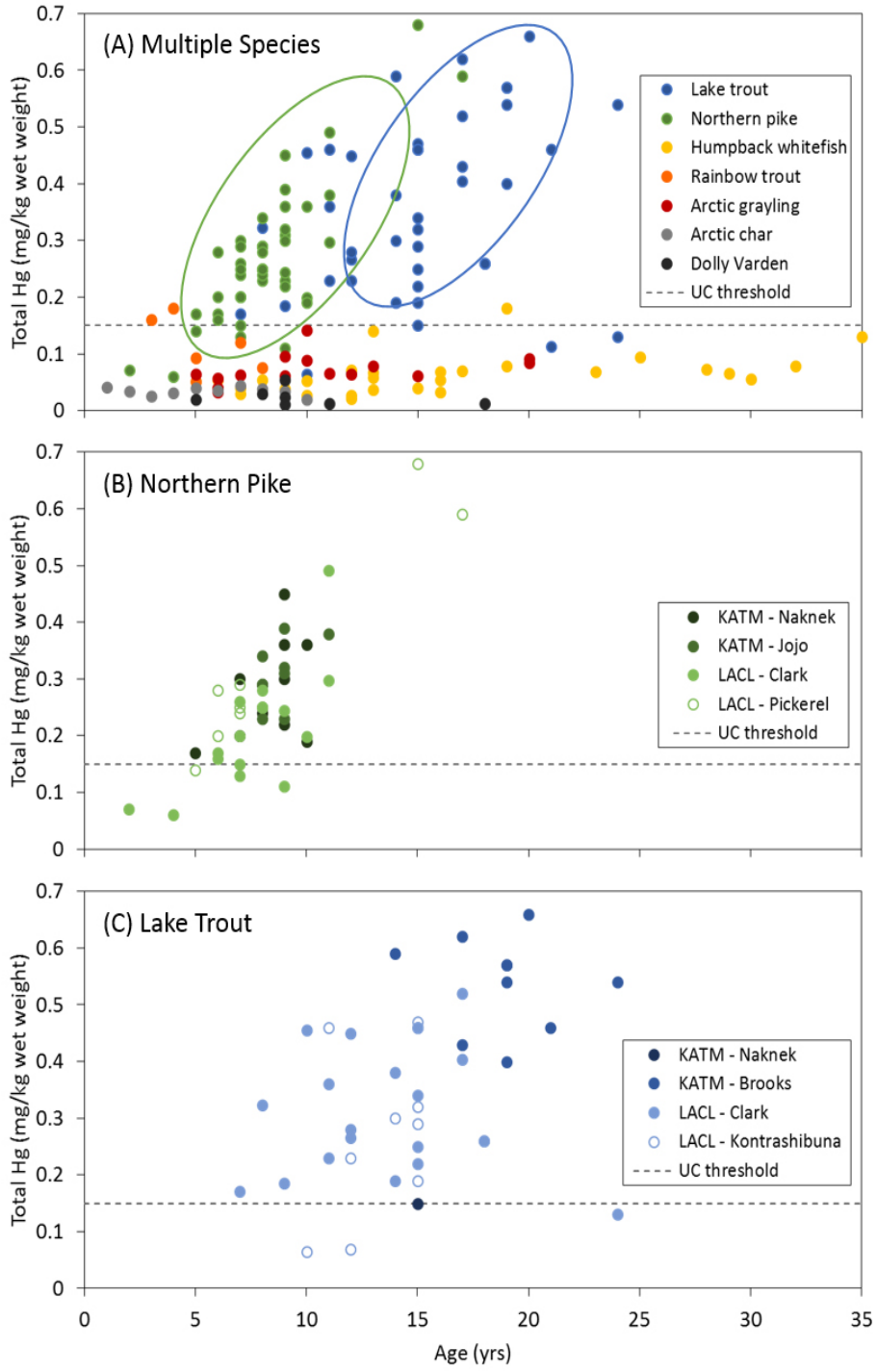


Figure 1. Total Hg levels in resident fish fillets are determined partly by fish age and species (A). However, even when age and species are accounted for, variability in Hg levels exists (B and C, which depict Hg in northern pike and lake trout, respectively). In all three graphs, the dashed line represents the upper limit for unlimited consumption (UC) of Alaska-caught fish, specifically for women of childbearing age, nursing mothers, and children under the age of 12 (Verbugge 2007).

Mercury Levels in Fish Tissue

Monitoring since 2005 has built a solid baseline of tissue samples from more than 250 fish, representing 9 species from 11 lakes in 2 park units. These samples indicate that resident fish in SWAN lakes have acquired elevated concentrations of mercury (Hg), the majority of which is methylmercury (MeHg), a toxic and readily biomagnified form. Why do fish from SWAN – which inhabit some of the most pristine and remote waters in North America – have such elevated Hg concentrations?

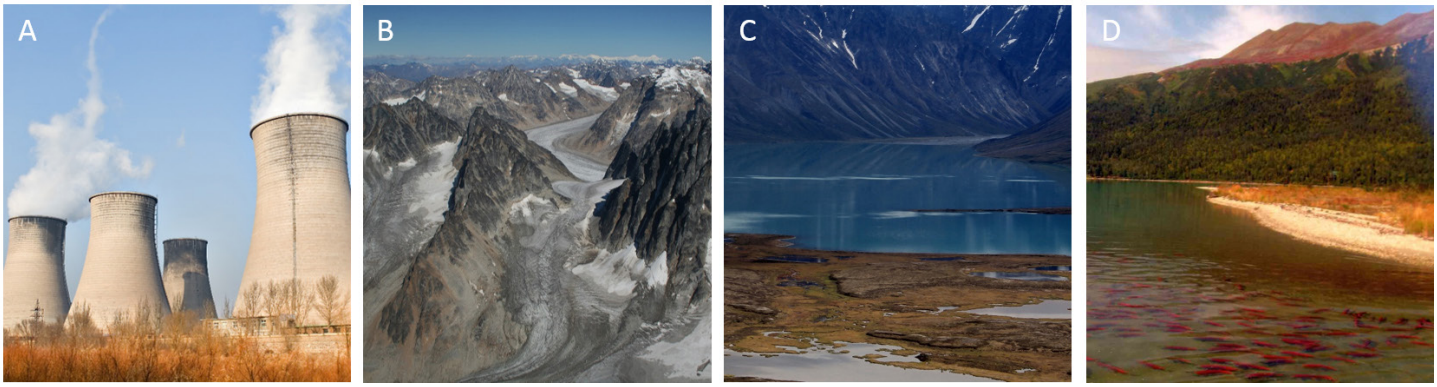
Lake trout collected from LACL in 2011. Photo: S. Huffman/NPS.

Factors driving fish Hg levels can be grouped into two broad categories: distant and local. Distant factors are atmospheric emissions (notably from coal burning), and subsequent long-range transport and deposition. Local factors, such as glaciers, wetlands, and salmon, influence the distribution of distantly derived Hg (Nagorski et al. 2014). Fish age and species also help determine Hg concentrations, in that older piscivorous species tend to have higher concentrations. Understanding the interplay of each of these factors will help make sense of the observed pattern in the Hg levels in SWAN fish (Fig. 1).

Monitoring Approach

Are contaminant concentrations increasing in fish that inhabit SWAN lakes? The first step in answering this question is to define current concentrations, in order to establish a baseline. To this end, biologists began collecting tissue samples of resident lake fish from select lakes within Lake Clark and Katmai National Parks and Preserves in 2005. Since then, the samples have been analyzed for heavy metals (e.g., mercury, arsenic, copper) and persistent organic pollutants (e.g., pesticides and various industrial and combustion by-products). Future monitoring will involve collecting and analyzing additional samples for heavy metals approximately every 5 years. Persistent organic pollutants will be analyzed less frequently (every 10-15 years), primarily due to the high cost of laboratory analysis.

Collecting fish samples on Portage Lake in LACL. Photo (right): D. Young/NPS.



Drivers of Hg concentrations in resident lake fish include both distant and local factors. Distant factors are predominantly atmospheric emissions from industrializing nations (A). Local factors include melting glaciers, which contain latent reservoirs of atmospherically deposited Hg (B); nearby wetlands, which convert atmospherically deposited Hg to MeHg through bacterial respiration (C); and spawning salmon, which import MeHg acquired while at sea (D). Photos: StockFreeImages.com, C. Lindsay/NPS, E. Booher/NPS, and D. Young/NPS.

Day's catch from Lake Brooks in KATM. Photo: A. Shulstad/NPS.

Importance

SWAN consists of five park units encompassing 9.4 million acres. Within this vast area exist hundreds of remote, near pristine lakes. Resident fish inhabiting these lakes play a key role in subsistence and recreational fisheries, so understanding their contaminant levels is crucial.

There is growing concern that fish species in some SWAN lakes have acquired elevated levels of contaminants such as mercury (Hg). Contaminants can bioaccumulate in fish tissue, especially in long-lived, predatory species like northern pike (*Esox lucius*) and lake trout (*Salvelinus namaycush*). When contaminants in fish tissue reach high enough concentrations, fish consumption advisories can be placed on a particular water body or fish species. Given the importance of resident lake fish as a food source for subsistence users, elevated contaminant levels in fish populations have human health ramifications, as well as broader ecological consequences.

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